Troubles with Turbines.—As has been previously pointed out, turbines may run away because the governors are prevented from acting by the effect of impure boiler feed-water. The kind of accident that may arise with governor gear is well illustrated by a trouble which actually arose with a turbine-driven boiler feed-pump. This little set consisted of a centrifugal pump direct-coupled to a single-wheel impulse turbine. The pump was delivering water at a higher pressure than that of the steam which was used to supply the turbine. The governor gear was operated on the " plunger principle ", i.e. a piston in a cylinder was controlled by steam on one side and water on the other, and a spring was provided so that when the water pressure exceeded or fell short of a certain amount, the piston was driven upwards or downwards, and so controlled the admission of steam to the turbine. After a few weeks' work the governor plunger was not perfectly tight, and as the water on the one side was at a higher pressure than the steam on the other, the water leaked past it into the steam side until it overflowed into the main steam-pipe. As the steam was superheated, the water was quickly evaporated in the steam chest of the turbine pump, and as the water was not pure a deposit was left behind which settled on the emergency main governor valve gear. The pump had to be frequently taken apart and cleaned, but on one occasion it had fouled quicker than usual, and the main and emergency governor gear fouled simultaneously, with the result that the turbine ran away. The moral of this fact is—quite apart from questions of boiler corrosion—keep your boiler water absolutely pure. It is dangerous not to do so.

Naval engineers know the necessity of pure boiler water even more than power-station engineers. With the very fast-steaming non-superheating boilers which are used on destroyers, for instance, a little salt water in the boiler water may cause priming to take place, and put the destroyer com-pletely out of action by damaging its turbines just at the critical moment when it requires its utmost speed.

Other troubles may overtake the turbine, such as the

stripping of the blading in the case of the reaction turbine, or the fracture of the diaphragm nozzles, or even the wheels, in the case of the impulse turbine. These troubles may arise from sudden changes in temperature. The stripping of a turbine may also be caused by allowing the boiler water to get very muddy. Considerable quantities of mud are blown over with the steam through the superheater until it deposits on the blades. Cases have been known where the turbine has been completely choked with mud, so that the pressure put on to the blading has caused it to bend until it has fouled the standing blades, thus causing a strip. Or again, the failure of a reaction-type turbine may be due to the manner in which it is started up. Much care is necessary in this operation to see that the turbine is, as far as possible, equally heated up throughout its high-pressure portion. The most fatal thing is to warm it up comparatively slowly. This allows a little trickle of steam to flow through it at one particular point, say at the extreme top or bottom. This may be sufficient to heat the spindle up in that position, and to cause it to